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A description of bone density of osteoporosis patients with femoral neck fracture

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Abstract

Aim: In this study, we aimed to describe clinical traits and bone density of osteoporosis patients with femoral proximal fractures on the Vietnamese elderly.

Materials and Methods: This cross-sectional descriptive study included 152 patients over 65-year-olds with femoral neck fracture treated.

Results: Male/female ratio was 0.88, average age was 77.25 ± 8.64 years. Common clinical symptoms were pain or irritation across long bones (69.1%), reduced height at more than 3cm compared with earlier ages (38.2%). Radiographs show that 64.5% of patients had intertrochanteric fractures, 63.2% of patients had Grade 3 femoral neck condition according to Singh Index. Average bone density measured by the DEXA scan of the femoral neck was -2.87 ± 0.39 and of the lumbar spine was -3.74 ± 0.71. Bone density results of the Singh Index and DEXA scan had a rigid, positive correlation ($p < 0.05$).

Discussion: Aspects of gender, age, BMI index, lifestyles, menopause time and the number of children were discussed to show a correlation with results from Vietnam and others. Some initial clinical symptoms suggesting osteoporosis risks and types of hip fractures were assessed. Singh Index and DEXA scan measurements were compared and evaluated, showing a rigid correlation.

Conclusion: Osteoporosis and osteoporosis-related femoral neck fractures occurred more in female than in male patients. Risk factors included a sedentary lifestyle, long menopause and many children in female and unhealthy lifestyles in males. Some clinical symptoms might early suggest osteoporosis conditions. There was a correlation between bone density measured using the Singh Index and DEXA scan, implying that the Singh Index still a valuable tool for initial diagnostic of osteoporosis and bone fracture prevention.

Keywords

Femoral Neck; Fractures; Bone Density; Osteoporosis

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Introduction

Osteoporosis is a bone disease with reducing bone mass and bone structure degeneration, which leads to an increase of bone fragility, i.e., fracture rate. Osteoporosis progresses naturally and silently with atypical clinical symptoms usually underestimated by the patients – 30% of the bone mass had already been lost when apparent symptoms or fractures occur. Risk factors of Osteoporosis include old age, gender (menopause in women increases bone loss), lifestyles (alcoholism, too little exercising, smoking), and some diseases and medication intake (hyperthyroidism, kidney disease, ovaries removal, corticoid, chemotherapy, etc.) [1-3].

In 1999 there were 1.7 million femoral neck fracture patients worldwide, and this number may reach 6.3 million in 2050, half of which occurred in Asia. Bone fractures due to osteoporosis were seen in 150000 patients annually in France, 70000 of them had femoral proximal fractures. Amongst patients, 80% did not fully recover after treatment, 40% required assistance in travel, and 25% died within one year. Treatment costs reached 1 billion euros. In America annually, there were 1.5 million bone fracture cases due to osteoporosis, 20% of whom got repeated fracture, 50% retain walking ability, 3 - 10% died in hospital, 14 – 36% died after one year. In Vietnam, it is estimated that 2.8 million people suffered from osteoporosis, accounted for 30% of women aged over 50 [5]. According to the initial survey data of the National Institute of Nutrition, osteoporosis affects about 1/3 of women and 1/8 of men over 50 years old. It is estimated that by 2030, the number of people with femoral neck fracture due to osteoporosis will be 41,000 cases (Bulletin of Ministry of Health, Mar 09, 2018, in Vietnamese).

Diseases should be prevented from the beginning, and for osteoporosis prevention, risk factors identification, early detection, and effective preventive care to avoid complications are considered critical. This study was carried out with the aim of a description of clinical traits and bone density of osteoporosis patients with femoral proximal fractures at the 7A Military Hospital, Hochiminh City, Vietnam.

Material and Methods

One hundred fifty-two patients diagnosed with osteoporosis according to WHO criteria (T-score ≤ -2,5) and femoral proximal fractures on radiographs in the 7A Military Hospital (Ho Chi Minh City, Viet Nam) from July 2015 to July 2019 were included in the study.

Participation in the study was voluntary. Criteria for rejection included cancer patients, patients unable to attend interviews. Research methods included description, study design, cross-section, case-by-case analysis, and total sample size. Clinical history, clinical examinations, and tests, bone density, were recorded for all patients with intertrochanteric fractures, data were collected using a unified form.

Research clinical criteria were as follows:

1. Interview: disease history, careers, lifestyles (sedentary or active), habits (smoking, drinking), menstruation (for females), fracture history, parental fracture history, drug-taking history, diabetes history (duration, treatment, complications).

2. Organs and full-body checkups, examinations of accompanying injuries. Measurements of blood pressure, height (low: < 1.47m for women, < 1.57m for men), weight (low: < 42kg for women, < 50kg for men), BMI calculation, detection of accompanying secondary fracture factors.

Research sub-clinical criteria were as follows:

1. Radiographs of hip joints from both sides in the supine position were recorded. Fractures were recorded and evaluated osteoporosis using Singh Index [4]. The Singh Index assesses bone condition based on gradual trabeculae losses shown on radiographs. Bone quality was classified into six grades in which grade 6 was the reasonable condition, and level 1 was severe osteoporotic bones.

a) Grade 6: All visible normal trabecular groups and fully occupied cancellous bone at the femoral proximal end.

b) Grade 5: Clear, prominent principal tensile and principal compressive trabeculae and Ward's triangle.

c) Grade 4: Significantly reduced principal tensile trabeculae but traceable from the lateral cortex to the femoral neck upper part.

d) Grade 3: Discontinuity of the principal tensile trabeculae opposite the greater trochanter. Indication of osteoporosis.

e) Grade 2: Only principal compressive trabeculae remain strongly visible; others have essentially vanished.

f) Grade 1: Principal compressive trabeculae are significantly reduced in number and are no longer prominent.

2. Bone density was measured by Dual-energy X-ray absorptiometry (DEXA) scan using MEDIX DR equipment (France) at femoral head, neck, greater and lesser trochanters, intertrochanteric line, Ward triangle, and lumbar spine (L1, L2, L3, L4). The final value was the averaged sum of all measured parameters.

3. Osteoporosis was diagnosed according to WHO criteria (Assessment of fracture risk and its application to screening for postmenopausal osteoporosis. Report of a WHO Study Group. World Health Organ Tech Rep Ser. 1994;843:1-129) based on bone density:

a) Normal: ≥-1 SD;

b) Osteopenia: -1 SD to -2.5 SD;

c) Osteoporosis: ≤-2.5SD;

d) Severe osteoporosis: ≤-2.5SD in the presence of one or more fractures.

Data analysis: The data were processed by the medical statistical method using SPSS software 16.0, and the hypothesis test was done by the Chi-squared method.

Results

Patients' general information

There were more females than males in a total of 152 patients (53.3% to 46.7%), average age was 77.25 ± 8.64 years (min. 64, max. 95).

Table 1. Height, weight, and BMI of investigated patients

Parameters	Results (X ± SD)		
	Male	Female	Average
Height (m)	1.63 ± 0.04	1.42 ± 0.05	1.51 ± 0.09
Weight (kg)	51.57 ± 5.8	44.52 ± 4.93	45.3 ± 6.49
BMI	19.23 ± 2.11	19.18 ± 1.72	19.11 ± 1.82

The physical features (height, weight, and BMI) of the patients were described in Table 1. Most patients had moderate height and low weight. Average BMI was on the lower side of the normal level (19.11 ± 1.82).

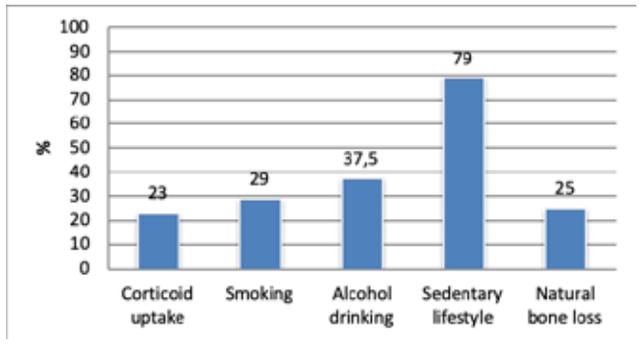

Figure 1. Historical records of several bones loss risk factors

Patients' historical records of several bones loss risk factors were presented in Figure 1. Among several different risk factors for bone loss, a sedentary lifestyle is most frequently occurred (79%), the second was alcohol drinking (37.5%), and the least was a natural loss due to old age and corticoid uptake (25% and 23%, respectively).

Most female patients gave birth more than thrice (55 patients, 67.9%) and were over 30 years postmenopausal (57 patients, 70.4%), and 14 patients were in their early menopause (17.3%) (n=81).

Many patients had one or more chronic diseases, including diabetes (20 patients, 13.2%), gastroduodenal diseases (26 patients, 17.1%), chronic kidney diseases (17 patients, 11.2%), chronic joint diseases (49 patients, 32.2%), chronic lung diseases (10 patients, 6.6%), and hypertension (51 patients, 33.6%). Chronic joint disorders and hypertension occurred at the highest rates amongst studied patients (32.2% and 33.6%, respectively).

Clinical traits and bone density

There were some osteoporosis-indicated clinical symptoms before bone fractures occurred; most patients had pain or irritation across long bones (105 patients, 69.1%). Other common symptoms were decreasing in height >3cm comparing to previous younger height (58 patients, 38.2%) and kyphosis and lordosis (46 patients, 30.3%).

When being examined in the hospital, most patients showed clinical symptoms of bone fractures, such as shooting pain (140 patients, 92.1%), shortened limb (122 patients, 80.3%), paralysis (116 patients, 76.3%), and impaired movement (42 patients, 27.6%).

On radiographs, the majority of femoral neck fractures were intertrochanteric, accounted for 64.5%; the remaining 35.5% were other types fractures.

Based on the Singh index, the majority of patients had bone condition grade 3 (96 patients, 63.2%), 45 patients had grade 2 conditions (29.6%), and 11 patients had grade 4 (7.2%). There were no patients with grade 1 or grade 5-6 bone conditions based on the Singh index.

Table 2. Average bone density of studied patients measured by DEXA scan

Positions	X ± SD		
	Males	Females	In general
Femoral neck	-2.86 ± 0.85	-2.88 ± 0.43	-2.87 ± 0.39
Lumbar spine	-3.57 ± 0.64	-3.82 ± 0.77	-3.74 ± 0.71

DEXA scan results of bone density were collected, analysis, and presented in Table 2. In general, the measured average bone density at the femoral neck was higher than that at the lumbar spine (-2.87 ± 0.39 and -3.74 ± 0.71, respectively).

Table 3. Correlation between the femoral neck and lumbar spine bone density with osteoporosis conditions based on the Singh Index

Parameters		Femoral neck density	Lumbar spine density
Osteoporosis conditions based on Singh Index	R	0.743	0.809
	P	< 0.001	< 0.001

Correlation between bone density measured by the DEXA scan and osteoporosis conditions based on the Singh Index ($p < 0.05$) is shown in Table 3 and Figure 2.

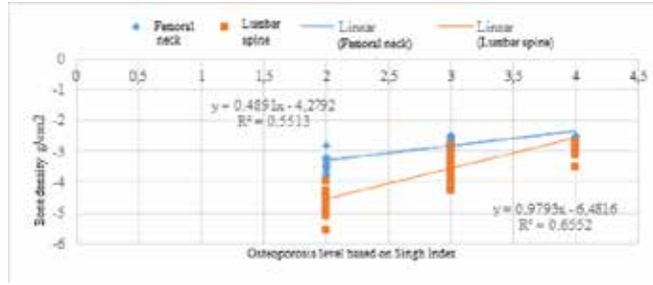

Figure 2. Correlation between the lumbar spine and femoral neck bone density with osteoporosis conditions based on the Singh Index

There was a strong, positive correlation between the lumbar spine and femoral neck bone density measured by the DEXA scan with radiographic osteoporosis conditions based on Singh Index.

Discussion

One hundred fifty-two patients were investigated in this study, 46.7% were males, and 53.3% were females; the average age was 77.25 ± 8.64 years. Intertrochanteric fractures took place in 64.5% patients, osteoporosis conditions of 92.8% patients were at Grade 2 and 3 according to Singh Index.

Many studies showed that obesity and excessive weight reinforces bone density. Survey of Dao et al. (2009) on osteoporosis in older women observed that for BMI < 23, the illness rate was significantly higher in the experimental group than in the control group ($p < 0.001$) [6]. Our research observed that patients with BMI < 23 took a significant portion in the study group (87.5%).

Effect of lifestyle on bone loss. Regular exercises are essential for the elderly since, after retirement, most of them choose to rest, stay at home more, and work lightly. Doing exercises at least five days a week, 30 minutes a day can promote health, increase bone density, improve circulation, reduce blood sugar; it also maintains muscular quality and reduces the chance of falling, thus more or less prevent osteoporosis and fractures in senior citizens [7,8]. In this study, 79% of the patients had a sedentary lifestyle making it the most frequently encountered risk factor. Other lifestyle risk factors for bone loss are smoking and alcoholism [2]. Most of the male patients in our study smoked (59.2%) and frequently consumed alcohol (78.9%) (n=71).

Effect of menopause on the loss of bone mass. Menopause is a natural physiological phenomenon in women. Postmenopausal estrogen level drastically decreases. Rapid bone loss occurs during the first 5 – 15 years after menopause, followed by a slow loss due to a lack of estrogen and old age. That means a higher period equal to longer postmenopausal time, which leads to more significant bone loss and higher risks for osteoporosis and osteoporotic bone fracture in women [7,9]. In this study, most female patients (n=81) menopause lasted over 30 years, accounted for 70.4% comparing to only 14 female patients who were in their early menopause (17.3%).

The number of offsprings is one essential trait of female reproduction. Reginster and colleagues (2005) [10] observed that mothers of many children had higher osteoporosis risks than mother of few since many births affected mother's calcium metabolism due to transfer from mother to child during pregnancy and breastfeeding; without adequate calcium re-supplement in these periods, women with many births will suffer from high osteoporosis risks. Also, Vietnamese women tend to refrain from movement and eating during several first months after birth. Women with more than three children were also a majority in this study (67.9%).

Clinical traits and bone density

Osteoporosis is a silent disease without apparent symptoms. As a result of many patients, especially men, were not aware of their illness until bone fractures occurred. However, the senior patients in this study showed several symptoms such as pain or irritation across long bones (105 patients, 69.1%), decreasing in height >3cm comparing to previous younger height (58 patients, 38.2%), and kyphosis and lordosis (46 patients, 30.3%). Although no symptoms do not mean healthy or such signs always mean osteoporosis, the above mentioned signs, albeit not specific for this disease, may remind the clinicians of osteoporosis risks as such risks are very high in patients with these symptoms [11,12].

Senior people have a reduced bone quality, which, even in the case of simple falling with small impact, quickly leads to femoral proximal fractures [2]. In this study, intertrochanteric fractures were seen in 64.5% of cases, and other fractures accounted for 35.5% cases, compatible with the significant researches of Guyton (2003) [13] and Lorich (2004) [14]. Classification of intertrochanteric fractures may help in the selection of treatment equipment and methods.

Our study showed that bone density at the femoral neck was higher than that at the lumbar spine (-2.87 ± 0.39 and -3.74 ± 0.71, respectively), which is compatible with the literature since the lumbar vertebrae (L1 to L4) are spongy bones with higher annual bone loss than compact ones. Therefore osteoporosis in the lumbar spine took place earlier than in the femoral neck [12].

Osteoporosis levels, according to the Singh Index in this study, were mostly in Grade 3 (63.2%). There was a rigid, positive correlation between bone density measured by DEXA scan and osteoporosis assessment using the Singh Index. Some other authors otherwise reported that there was little to no correlation between Singh Index and DEXA scan bone density measuring [15]. Vietnam is still a developing country and expensive diagnostic tools as DEXA might not be readily available in many hospitals and be a financial burden to many patients. Based on our result, the Singh Index is still a valuable way to initially assess osteoporosis and give a useful hint about the patients' bone conditions for further examination and treatment.

Conclusion

Osteoporosis and osteoporosis-related femoral neck fractures occurred more in female than in male patients. The most frequently encountered risk factor, in general, was the sedentary lifestyle. Most female patients had long menopause and many children, while most male patients had unhealthy lifestyles such as smoking and alcoholism.

Although not significantly specific to osteoporosis, some clinical symptoms such as pain and irritation across long bones or highly decreasing in height might early suggest osteoporosis conditions.

There was a rigid, positive correlation between bone density measured using the Singh Index and DEXA scan, implying that the Singh Index is still a valuable tool for initial diagnostic of osteoporosis and bone fracture prevention.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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Conflict of interest

None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

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